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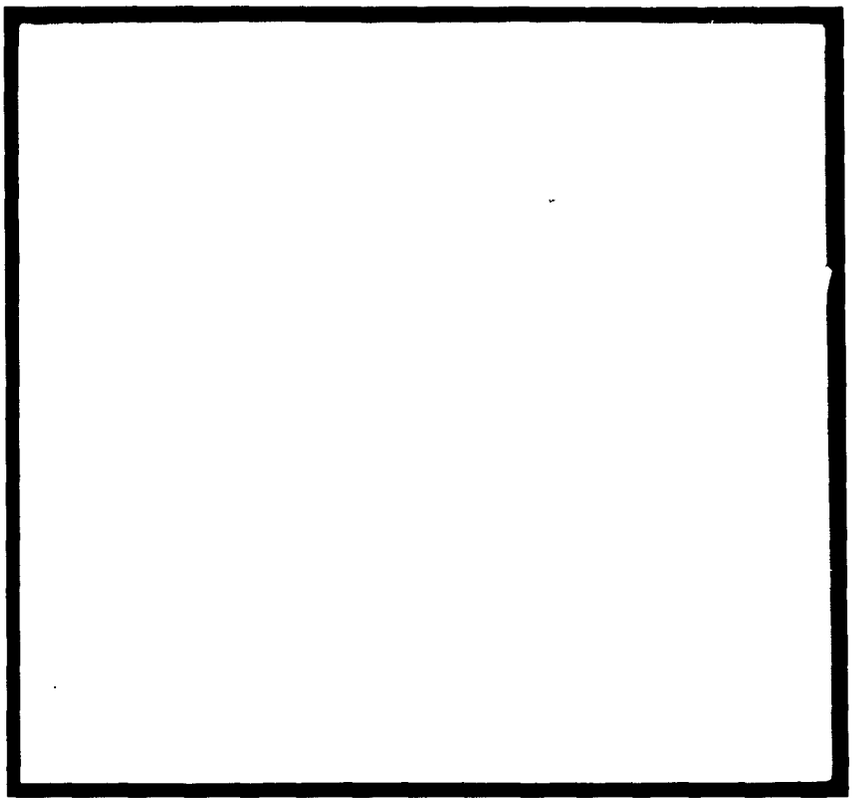



BORG-WARNER CORPORATION
INGERSOLL KALAMAZOO DIVISION
1810 North Pitcher Street, Kalamazoo, Michigan

# STRESS CORROSION TEST RESULTS

Supplement #1 to Project Report SPDIR-26

Contract NOrd 15719 July 15, 1963

Copy No. 52

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Stress corrosion test results are given for[1]

## INTRODUCTION

On April 18, 1962 seventy-two ~~(72)~~ bent beam specimens of two high strength, high carbon steels ~~were~~ exposed to an industrial atmosphere. Half of these specimens ~~had been~~ were[1] given surface decarburization whereas the other half remained in the base metal condition. Partial results of these tests were reported in Project Report SPDIR-26, "The Effect of Surface Decarburization on the Notch Sensitivity of MBMC #1, Super Tricent and AISI 9262 Steels", dated July 15, 1962 under Contract NOrd 15719. On June 18, 1963 the stress corrosion tests were terminated. The complete results of these tests are presented herewith as Supplement #1 to the aforementioned report.

also see AD 281215

## STRESS CORROSION TESTING

A total of seventy-two (72) bent beam specimens were obtained by power spinning cylinders from forgings to the desired thicknesses of 0.050" and 0.100", longitudinally parting and unrolling the cylinder and shearing out the specimens. Half of the specimens were of MBMC #1 steel and the other half of Super Tricent steel. The specimens were heat treated in a laboratory furnace with facilities for controlling the furnace atmosphere. The furnace was controlled to produce two groups of specimens, those having no surface decarburization - base condition, and those having a nominal depth of surface decarburization - of 0.005" on the 0.050" thick specimens and 0.010" on the 0.100" thick specimens.

The specimens were tested in the as heat treated condition to simulate the actual surface condition of missile casings.

The method of testing was based upon the fixturing and stressing technique developed by Dr. E. H. Phelps and Mr. A. W. Longinow of the Applied Research Laboratory, U. S. Steel Corporation, Monroeville, Pennsylvania. The specimens were placed flat in the holder and then the length between supports was reduced thereby causing a deflection and corresponding stress in the specimen. Three specimens were placed in each holder and bent to specific radii calculated to exert surface fiber stresses of 150,000, 175,000 and 200,000 psi on the base specimens. Since the mechanical properties of steel surface were lowered by decarburizing the exact determination of

stress in this layer was quite involved and beyond the scope of these relatively simple and low level of effort tests. To serve as an approximation of stress, the decarburized specimens were bent to the same deflection as were the base specimens for each of the three stress levels.

All specimens were exposed to an industrial atmosphere on April 18, 1962. The test was terminated fourteen (14) months later on June 18, 1963.

Figures 1, 2 and 3 illustrate the equipment used and procedure. Figure 4 shows the classification breakdown of the specimens tested and Figure 5 shows all specimens mounted and placed on the roof at Ingersoll Kalamazoo Division.

Figure 1. Mounting Fixture used for Bent Beam Specimens

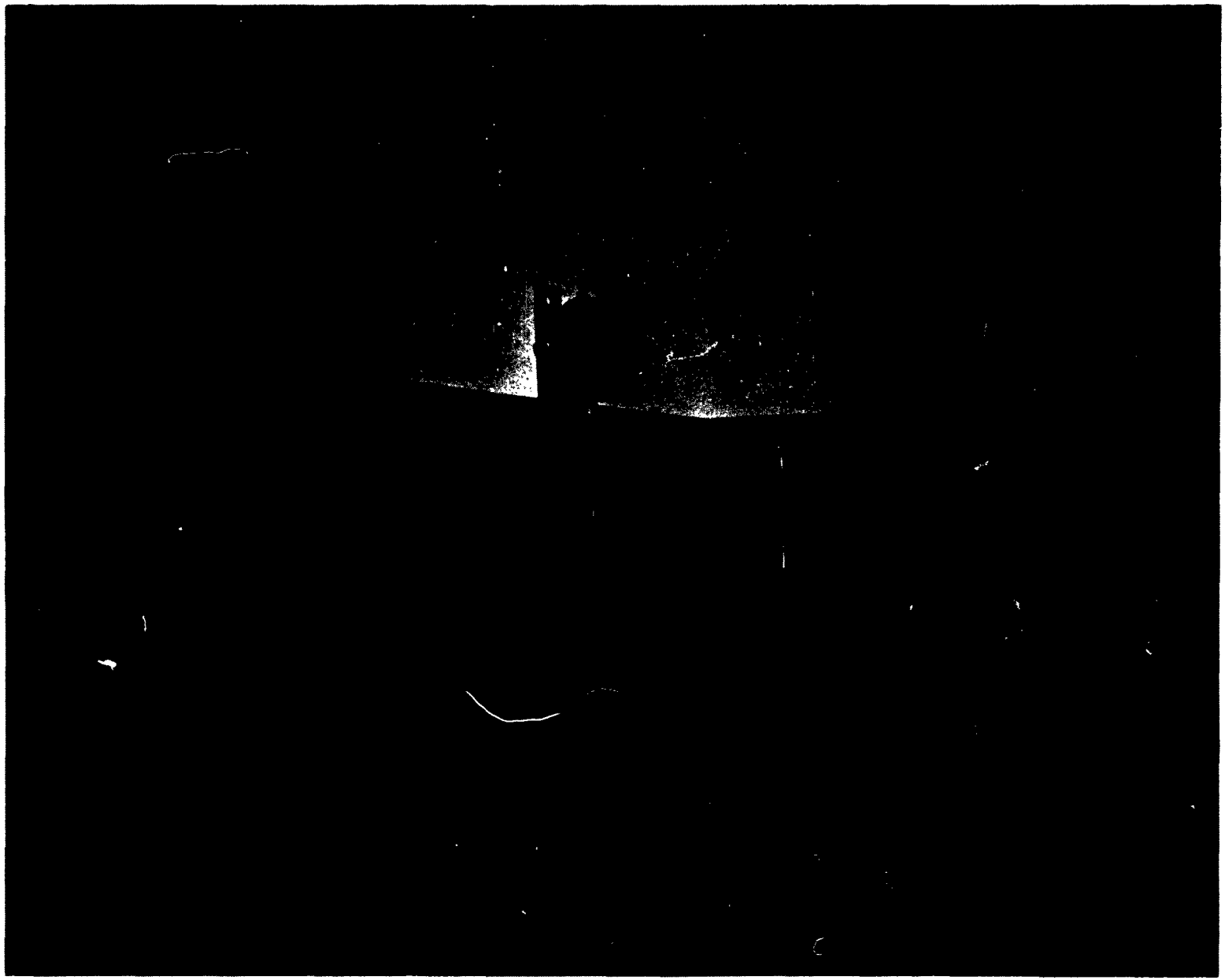

**Figure 2. Bent Beam Specimen being given a Desired Deflection**

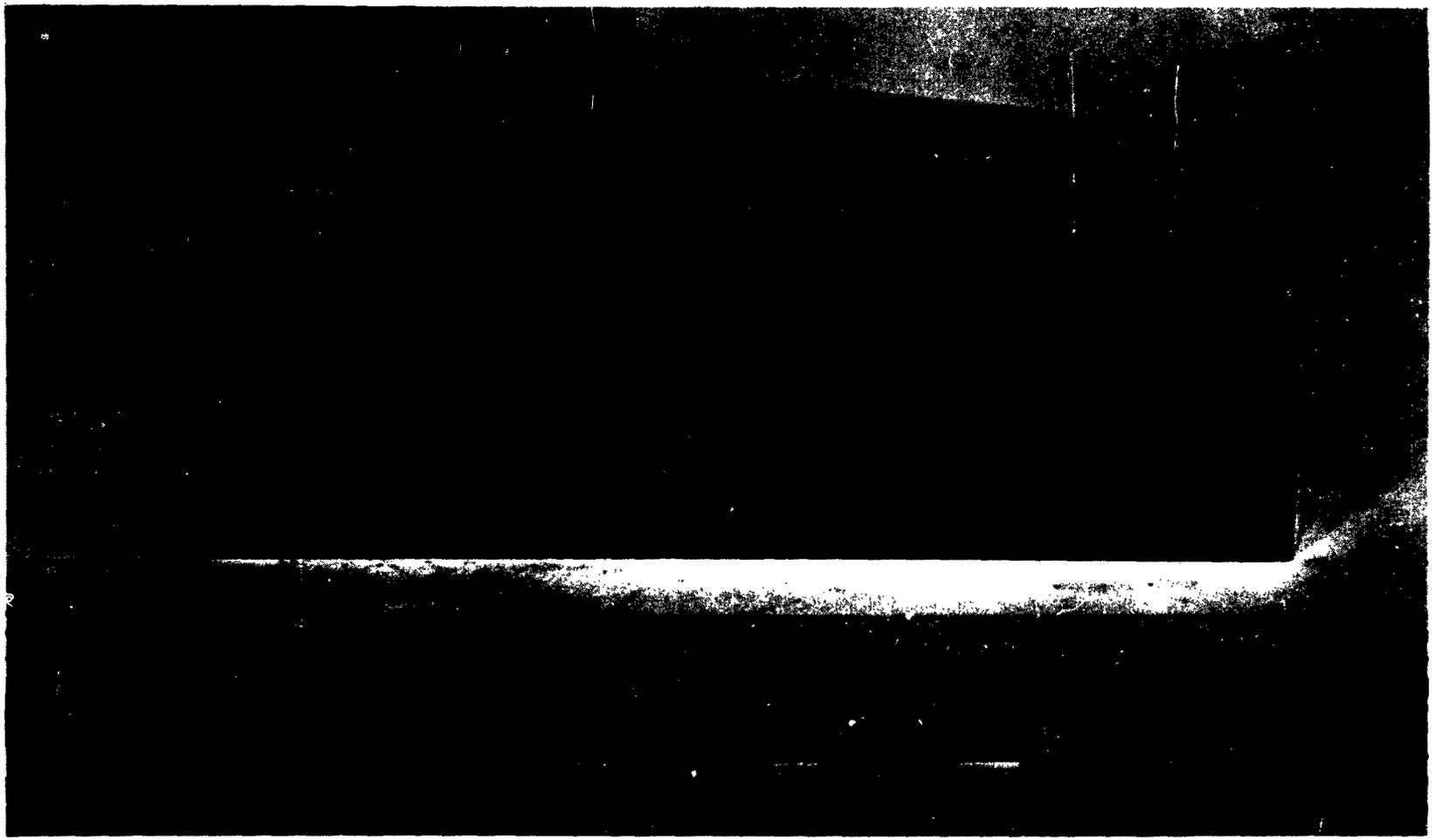

**Figure 3. A Loaded Fixture showing Three Stressed Specimens**

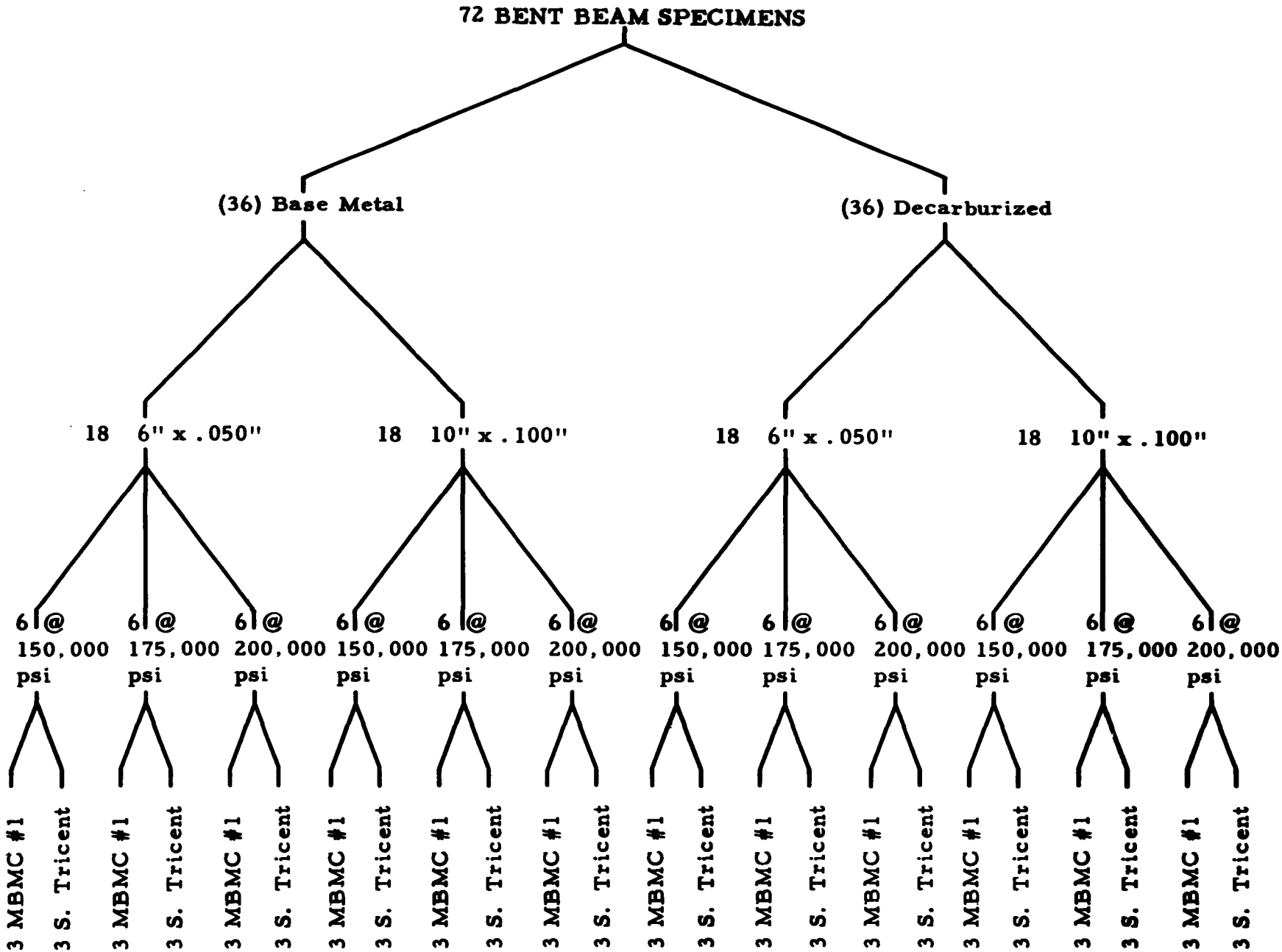


Figure 4. Schematic of Bent Beam Specimens Tested

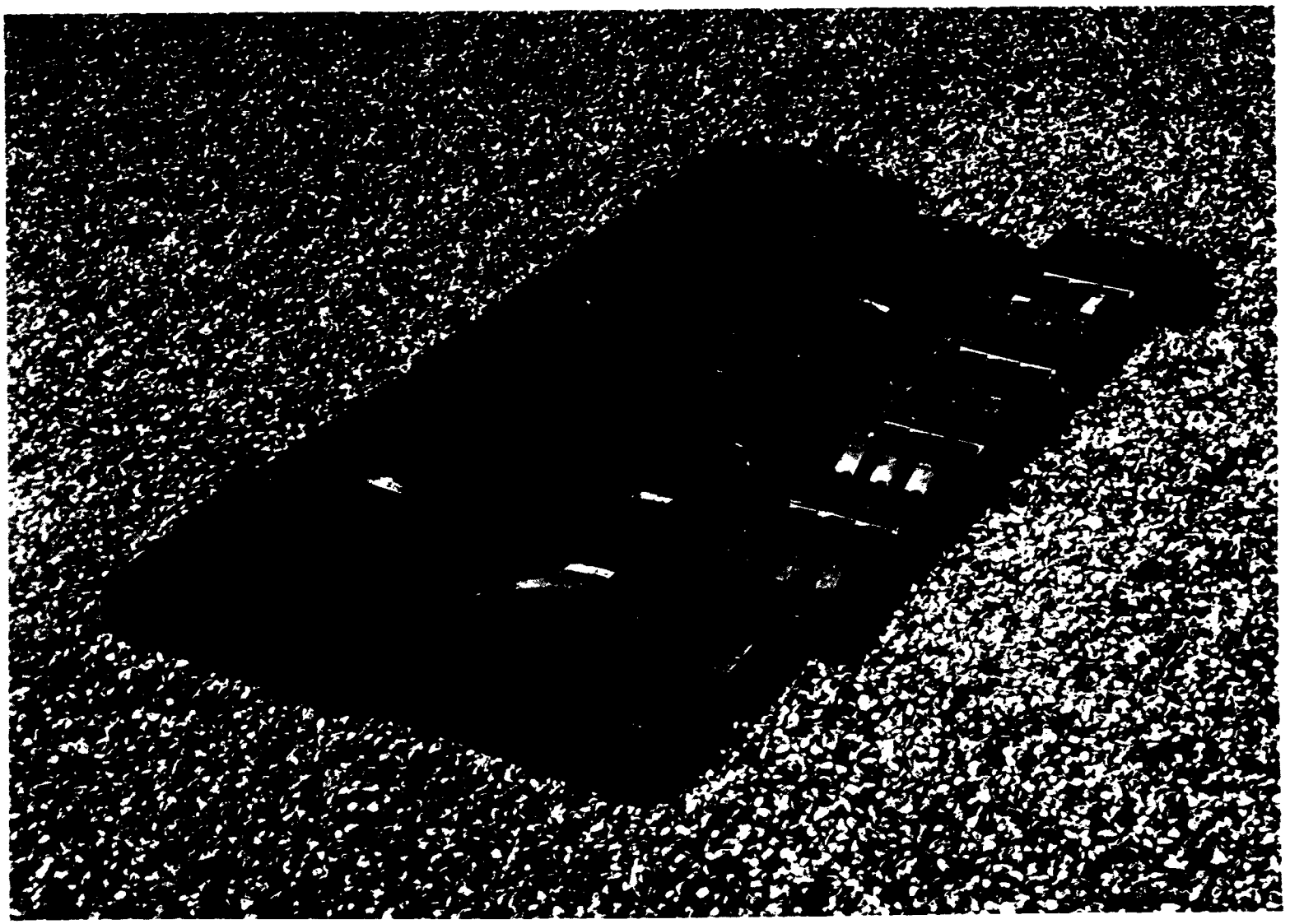

Figure 5. Specimens Mounted and Placed on the Roof at Ingersoll Kalamazoo Division

## RESULTS

The average days to failure for the three specimens within each group are shown in Table I. In instances where one, two or all three specimens within a group did not fail during the 14-month period the life of these specimens was taken as at least 14 months or 426 days.

## CONCLUSIONS

1. Surface decarburization is effective in significantly reducing stress corrosion failures for the two high carbon notch sensitive steels tested.

2. Decarburized MBMC #1 steel exhibited higher resistance to stress corrosion failure than did decarburized Super Tricent steel.

Table I. Stress Corrosion Test Results

| Steel | Base or Decarb | Size Length x Thickness - Inches | Stress Level ksi | Number of Specimens | Failure Time Range - Days | Average Days to Failure |
|---|---|---|---|---|---|---|
| MBMC #1 | Base | 6 x 0.050 | 150 | 3 | 3-5 | 4 |
| | | | 175 | 3 | 3-10 | 5 |
| | | | 200 | 3 | 3-4 | 4 |
| | Decarb | 6 x 0.050 | 150 | 3 | No failures | 426+ |
| | | | 175 | 3 | No failures | 426+ |
| | | | 200 | 3 | 63-125 | 94 |
| | Base | 10 x 0.100 | 150 | 3 | 13-86 | 46 |
| | | | 175 | 3 | 5-28 | 19 |
| | | | 200 | 3 | 5-21 | 13 |
| | Decarb | 10 x 0.100 | 150 | 3 | 289-426 | 380+ |
| | | | 175 | 3 | 264-426 | 372+ |
| | | | 200 | 3 | 276-426 | 345+ |
| Super Tricent | Base | 6 x 0.050 | 150 | 3 | 37-43 | 39 |
| | | | 175 | 3 | 11-16 | 13 |
| | | | 200 | 3 | 3-11 | 8 |
| | Decarb | 6 x 0.050 | 150 | 3 | 152-426 | 335+ |
| | | | 175 | 3 | 62-199 | 124 |
| | | | 200 | 3 | 113-138 | 123 |
| | Base | 10 x 0.100 | 150 | 3 | 13-36 | 23 |
| | | | 175 | 3 | 12-32 | 22 |
| | | | 200 | 3 | 4-21 | 13 |
| | Decarb | 10 x 0.100 | 150 | 3 | 141-153 | 147 |
| | | | 175 | 3 | 23-175 | 74 |
| | | | 200 | 3 | 21-30 | 25 |

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